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AUTHOR Allen, Barbara
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ABSTRACT

Recent increased interest in content-based language instruction is due to new developments in second language acquisition theory, and to the need to provide equal educational opportunities to the growing number of immigrant children. Facets of second language learning that need to be developed in content-based instruction include specialized vocabulary, language functions for academic communication, language structures and discourse features associated with different disciplines, and classroom language skills. This language development component distinguishes content-based from traditional language instruction. An integrated approach to content-based instruction derives learning objectives from the academic content, language content, and ongoing assessment of the student's language skills. To foster communication, much content-based language instruction should be activity-centered. Interest in integrating mathematics content and English language instruction is relatively new and offers some pedagogical challenges for limited-English-speakers. At the elementary level, attention must be given to concepts, computation, applications, and problem-solving. A series of four class activities for grades 1-4 are designed to promote communicative language exchange in classroom settings while fostering mathematics learning. A brief bibliography is appended. (MSE)

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CONTENT-BASED SECOND LANGUAGE INSTRUCTION:

TEACHING ENGLISH THRQUGH MATHEMATICS IN GRADES 1 - 4

by
Barbara Allen
University of Northern Iowa
1990

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INTRODUCTION

Although much of traditional second language teaching focused on the study of the language per se, content instruction has always been important to some degree. As Mohan (1986:3) points out: "Even in the traditional Latin class, students often learned about Roman civilization, and learned Latin in the process of doing so." Especially at the more advanced stages of second language teaching, the history, culture, and literature associated with the target language have usually been given due consideration. Thus, content-based second language instruction has always been practiced to some extent. In recent years, however, the concept has been looked at and interpreted much more rigorously. According to Short (1989:1) content-based language instruction is now defined as an

> approach that integrates second language instruction with subject matter instruction. Each lesson in a content-based class has content objectives (e.g., math, science, social studies) and language objectives (e.g., grammar, functions). Students learn language through the context of specific subject matter rather than through isolated language features.

The key difference between earlier approaches to second language teaching and the current emphasis on content-based instruction is the realization that subject and language learning go hand in hand. In a content-based approach language learning is carefully coordinated and integrated with other curricular areas. It follows that cooperation between second language teachers and content teachers is essential. A number of different approaches

to integrating second language and content learning are currently in existence.

APPROACHES TO SECOND LANGUAGE AND CONTENT INTEGRATION

The recent increased interest in content-based language instruction is in part due to new developments in second language acquisition theory. Krashen (1981, 1982), who has been especially influential, posits that second language acquisition is in many respects similar to first language acquisition. Students will learn a language if they receive comprehensible, meaningful input. Proponents of content-based second language instruction argue that for the school child content classes such as math, science, and social studies deliver naturally meaningful language input.

The other driving force behind the development of content-based language instruction in the United States has been the sheer necessity of providing equal educational opportunities for a steadily growing number of immigrant children. According to Cantoni-Harvey (1987:4) language-minority children represent "17 percent of the school-age population in the United States."

In the past language-minority children were often simply placed in regular classrooms, receiving perhaps some special instruction in English in a separate class. The idea behind this laissez-faire approach was that students would learn English simply by being exposed to it in their school environment as well as in their

English speaking community. However, educators soon realized that these students fell behind in their academic subjects. Mohan (1986:7) notes that recent "research on language and learning in the content class suggests that we need more than a laissez-faire approach to help students with the language demands of the content class."

Furthermore, content teaching in and of itself does not necessarily foster language development. Swain (1988:68) warns that "not all content teaching is necessarily good language teaching." He observed many content classes and found out that their focus is usually meaning rather than language oriented. In such classes the students usually have little opportunity to speak, as only short answers are required. Swain goes on to suggest that systematic integration between content and second language teaching is needed if the students' understanding of form-meaning relationships is to be facilitated. It is obvious that if a content-based approach to language learning is chosen, special attention has to be devoted to the language development component.

Chamot (1985:50-51) sees four facets of second language learning that need to be developed in content-based instruction:

- Vocabulary and technical terms associated with the subject (e.g., math, social studies, science);
- Language functions needed for academic communication (e.g., informing, explaining, classifying, evaluating);
- Language structures and discourse features associated with different academic disciplines...;
- Language skills emphasized in the classroom for different academic functions...

It is this language development component that distinguishes content-based second language instruction from regular content instruction.

Snow et al. (1989) propose a conceptual framework for the integration of content and second language instruction. According to their model,

> language-learning objectives in a content-based program are derived from three sources: (a) the second/foreign language curriculum, (b) the content-area curriculum, and (c) assessment of the learners' academic and communicative needs and ongoing evaluation of their developing language skills. From these sources, two types of language objectives can be specified: content-obligatory language objectives and content-compatible language objectives (p. 205).

The authors stress that in such an integrated approach the language curriculum is altered so that "language objectives and content objectives compatible with each other are taught concurrently" (p. 206). They also point out how important it is for the content and second language teacher to work together.

Snow et al. apply their model to four different school settings: 1. the mainstream class - the mainstream teacher works closely with the ESL teacher and both plan to meet the linguistic needs of the limited English proficient (LEP) students in the content class as well as in the separate ESL class; 2. the ESL class - in this setting no special accomodations are made for LEP students in the mainstream class, but their separate ESL class explains and builds on concepts and vocabulary used in the content class; 3. the immersion class - in this situation the content teacher and the language teacher are the same; the immersion teacher has to be careful to develop content-compatible language; and 4. the FLES (foreign

language in the elementary school) class - in this setting foreign language objectives derive from the content-compatible language of the standard school curriculum. Not mentioned by Snow et al., but currently practiced in many American schools, is the sheltered class. In this setting LEP students are placed together in content classes in which the teaching of the content (e.g. math, social sciences, etc.) is adapted to their level of linguistic proficiency. Along with sheltered content classes students also take ESL classes.

In order to foster communication among students (and thus the use of the second language) much content-based second language instruction should be activity centered. Hudelson (1989:139-140) feels the following principles are important in developing content-based language instruction:

1. Students learn both content and language by being active, by doing things, by participating in activities directly related to specific content, and by using both oral and written language to carry out these activities...
2. Students learn both content and language by interacting with others as they carry out activities...
3. All of the language processes are interrelated...
4. Students learn to read by interacting with whole, authentic texts (by reading), and they learn to write by creating whole, authentic texts (by writing),...
5. Reading comprehension is facilitated by having prior knowledge of the text...

Thus, content and language objectives must be carefully coordinated, and learning should be mostly activity based.

INTEGRATING ESL AND MATHEMATICS

Probably because of the difficulty of the content, mathematics has traditionally not been considered a subject that could foster second language acquisition. However, in recent years educators have taken a second look at this subject area and realized some of its potential contributions to second language learning. First and foremost is the realization that mathematics teaches problem solving skills, and that such skills are transferable to all other areas of learning. Furthermore, solving mathematical word problems can help LEP students expand their vocabulary greatly. The names of any number of things, objects, animals, etc. can be incorporated into word problems and in this way give LEP students challenging opportunities to practice such new words in a meaningful way.

Another argument in favor of integrating mathematics and ESL is that in discussing mathematical problems relatively basic English can be used. The mathematical terminology, or the mathematics register, itself is, however, highly specialized and complex. But the subject-specific technical expressions will be new to native language speakers as well as to LEP students. In teaching LEP students one has to make sure that students understand that certain common English words have different, very specific meanings when used in a mathematical context.

Dale and Cuevas (1987) point out that the mathematics register

includes unique vocabulary, syntax, semantic properties, and discourse features. Students have to learn mathematical symbols, specific mathematics vocabulary (such as divisor, quotient, etc.), and re-learn everyday English words in a mathematical context (e.g., equal, rational, table, less, etc.). They also have to realize that one mathematical concept, such as, for example, addition, can be expressed by any of the following words: add, plus, combine, and, sum, increased by.

In the area of syntax students are confronted with expressions such as "greater/less than", "n times as much", "as... as", prepositions (8 divided by 4), etc. Dale and Cuevas (1987:15) note:

> One of the principal characteristics of the syntax used in a mathematical expression is the lack of one-to-one correspondence between mathematical symbols and the words they represent. For example, if the expression "eight divided by 2" is translated word-for-word in the order in which it is written, the resulting mathematical expression $8\sqrt{2}$ would be incorrect. The correct expression is $2\sqrt{8}$.

Logical connectors, such as "if .... then", "if and only if", "because", "that is", "for example", "such that", "but", "consequently", "either", etc. also present problems to students.

When translating word problems into mathematical equations students have to identify correct semantic references, something that is difficult for native speakers, but even more so for LEP students.

At the discourse level, Bye (1975) notes that mathematics texts lack redundancy and paraphrase, are conceptually packed, are of high density, require up-and-down and left-to-right eye movements, require a slower reading rate than natural language texts, require multiple readings, use a variety of symbols such as charts and graphs, and contain a large number of technical words with precise meanings. It is obvious from this that LEP students need special help with mastering the mathematics register.

Mathematics and ESL can be integrated in two ways: "(a) incorporating mathematics content into ESL instruction, and (b) incorporating English teaching strategies into mathematics instruction" (Dale & Cuevas 1987:11). In both cases the mathematical and language skills to be learned have to be analyzed.

Cuevas (1984) proposes an instructional model for dealing with English as a second language in the mathematics classroom. The approach is composed of two strands, one focusing on mathematics content, the other on language skills (mathematics specific language skills and related language skills). The mathematics and language skills needed are analyzed and diagnosed. The teacher then implements appropriate preventive and prescriptive activities. In summary, "teachers must analyze each mathematical task into mathematics and language skills. Instructional activities that integrate both kinds of skills must then be devised for the prescriptive and evaluation phases of the approach" (Dale & Cuevas 1987:37).

INTEGRATING ESL AND MATHEMATICS AT THE ELEMENTARY SCHOOL LEVEL

According to Dale and Cuevas (1987:32), the "mathematics curriculum at any grade level is generally composed of four basic areas: concepts, computation, applications, and problem-solving." When integrating ESL and mathematics the teacher has to pay special attention to language development in all of these four areas. The teacher cannot assume that LEP students are already familiar with any of the concepts that are dealt with in a mathematics lesson.

Dale and Cuevas (1987:30) note:

> Whenever possible, instructional activities, in both the ESL and the mathematics classroom, should be built on students' real-life experiences and prior knowledge of mathematics, and offer situations in which students can interact with the teacher and fellow students (both LEP and English-speaking). Such activities stimulate both second language acquisition and learning. ...when LEP students are provided with a classroom environment organized around interactive activities, they can acquire both mathematics and English simultaneously.

And Reilly (1988) summarizes: "Lessons that teach new concepts in mathematics should use graphics, manipulatives, and other hands-on, concrete materials that clarify and reinforce meanings in mathematics communicated through language."

Cantoni-Harvey (1987:131-132) stresses that in the elementary grades

> math instruction is predominently activity-oriented. The children abstract mathematical structures from concrete manipulative situations; the teacher provides appropriate materials, introduces new vocabulary, and manages the flow of physical and verbal responses. The classroom becomes a language-enriching environment that promotes literacy and cognitive abilities.

And Cortez (1983) has the following suggestions for adapting content area lessons for inclusion into the elementary school ESL curriculum:

1. Identify the key words in the lesson. (Many teacher's editions include the key words in the behavioral objectives.)
2. Summarize the key concepts.
3. Prepare several relevant sentences in keeping with the students' level of English proficiency.
4. Prepare and/or adapt appropriate comprehension questions concerning the gist of the lesson.

INTEGRATED ESL/MATHEMATICS ACTIVITIES FOR GRADES 1 - 4

The following examples of integrated ESL/mathematics activities have been selected with a view of promoting communicative language interchange in classroom settings. It is thought that the types of activities described in the following pages will foster mathematics as well as second language learning.

I have consulted the textbook series Mathematics Today, Harcourt Brace Jovanovich, Levels 1-4, to determine appropriate grade levels for the activities described on the pages to follow. For each activity I will also indicate mathematics as well as language objectives. The activities described could be used either in an ESL classroom or in mathematics instruction which emphasizes language development.

ACTIVITY #1: THE CONCEPT OF "SQUARE"

This activity is adapted from Cantoni-Harvey (1987:132-134).

Grade Level: 1

Mathematics Objectives: To introduce various geometrical shapes,

emphasizing the "square". To introduce the concept of a set. To learn to distinguish between the various geometrical shapes. Language Objectives: To introduce the words square, triangle, circle, rectangle, shape, set. Language used: This is a square. This is not a square. It is a rectangle, etc. Does this shape belong to the set of squares?

Related Language: This square is red, blue, etc. (colors). This square is bigger/smaller that that square (size comparison).

Materials needed: Use colored construction paper to cut out a variety of flat geometric shapes (squares, triangles, circles, rectangles) of various sizes and colors.

Procedure: Divide children into groups. Provide each group with a packet of shapes. Have children scatter shapes on the rug, and encourage them to play with the shapes. Various groups will sort the shapes by different criteria (shape, color, size). Go around and join in the groups. Discuss how they are sorting the shapes. Next, have a whole class activity in which you elicit the names of the various shapes and introduce the concept of a set. Names of shapes should be written on the blackboard. Have children attach various shapes on a feltboard according to your directions. Ask the various groups how they had sorted their shapes. Ask how a square is different from the other shapes. Have groups re-sort their shapes according to your directions. As a follow-up ask children to find square objects in the classroom. This activity could be repeated over a period of several weeks, each time emphasizing a different shape.

In first grade the mathematics curriculum covers counting (from 1

to 100), addition and subtraction (first up to 10, then up to 18), time and money, geometrical shapes, and measurement. These objectives lend themselves very well to language and vocabulary development. By bringing manipulative materials into the classroom (e.g. toys, or pictures of various things), students can count, add and subtract learning the words of the things they are counting, adding, or subtracting at the same time. Math worksheets could be done in groups (rather than individually). Math worksheets at this stage display the pictures of the items to be added, subtracted, etc. If the teacher would also supply the words in writing, students could expand their vocabulary greatly.

ACTIVITY #2: GROCERY STORE

This activity is adapted from Dale & Cuevas (1987:48-49).

Grade Level: 2

Mathematics Objectives: Choose or match sets of coins with values up to 99 ¢. Add prices up to 99 ¢. Compare prices with amounts of money.

Language Objectives: This costs ...cents. This costs as much as/less than/more than that. You need ...quarters, ...dimes, ...nickels, ...pennies to buy this item.

Related Language: Names of items commonly found in a grocery store. This activity is intended as a follow-up. Children are already familiar with the various coins and can add them up (up to 99 cents).

Materials Needed: Food containers or any other group of items for a grocery store.

Procedure: Set up a grocery store with as many items as possible, each with a clearly marked price on it. The store should be set up as a learning center to be used by one small group at a time,

while the other groups work on other problems. Groups should first have the opportunity to simply play "grocery store". They should have play coins and be able to "buy" desired items. Groups can later work on worksheets answering such questions as: Name one item that costs 25 cents. How many apples can you buy with 50 cents? What costs more, 3 apples or 3 oranges? What coins do you need to buy a toy car?

The grocery store is a rich activity for developing related language. As the store is set up, the word for each item can be elicited and written on the blackboard. If the item does not contain the name on the label, a label should be made and attached to the item. The word could, for example, be written on the reverse side of the price tag.

ACTIVITY #3: MONKEY MATH

This activity is adapted from Commins (1990: 128-129).

Grade Level: 3

Mathematics Objectives: To supply missing addends or subtrahends (addition facts up to 18).

Language Objectives: Pronunciation of numbers 1 through 18. Parallel writing, in two rhyming lines.

Related Language: Names of animals. Sentences describing everyday activities.

Materials Needed: "Monkey Math" sheet.

Procedure: Distribute "Monkey Math" sheet to students. On the sheet students find rhyming sentences, such as:

15 little monkey stayed up late,

____ went to bed and then there were 8.
There were 6 little monkeys waiting to dine,
____ more joined them and then there were 9.
There were 18 little monkeys learning to dive,
____ couldn't do it, which left only 5.

As the whole class works through the problems, explain any words not known to the children. After the correct numbers have been filled in, go through the whole worksheet using it as a jazz chant (this can be done several times, with slight variations). Then divide up students into groups and have them write similar rhyming couplets using other animals of their choice. Move from group to group during this activity and help students find the words they are looking for. Have groups interchange problems and solve them. Re-convene as a whole class and write students' couplets on the blackboard or on a big writing pad. Again, have the class shout the couplets in the form of a jazz chant. Later on, duplicate the couplets for all students and hand them out to them to keep.

ACTIVITY #4: WRITE WORD PROBLEMS FROM A WORD PROBLEM OUTLINE

This activity is adapted from Dale & Cuevas (1987:51-52) and Mathematics Today (Level 4=Orange), p. 127.

Grade Level: 4

Mathematics Objectives: To write a word problem from a word problem outline using basic multiplication and division facts. To solve a word problem using basic multiplication and division facts.

Language Objectives: Writing a basic story problem.

Related Language: This type of activity can be adapted to any topic. It would be best to have a "theme" for each set of word problems. Vocabulary can then be developed beforehand around this theme.

In our example the theme is "At the Airport." Vocabulary related to airports should be developed (e.g., airline, (air)plane, ticket counter, ticket, terminal, aircraft, hangar, bus, truck, passenger, etc.) Some sample word problems should be solved within the whole class. Students are then divided into groups. Each group is given several word problem outlines. They are charged with writing story problems using the outlines. Each story problem should be related to activities at an airport.

Example: Outline

4 ticket lines
9 people in each line
How many people in all?

Story Problem

The airport terminal is very busy. At one airline counter there are 4 ticket lines with 9 people in each line. What is the total number of people in line?

During this activity the teacher should visit with each group, acting as a resource. Groups can exchange problems and solve them. Selected problems can be discussed within the whole class.

SUMMARY

The activities described above indicate that mathematics can have a great potential for language development. Hands-on, manipulative experiences foster communication. The possibilities for developing

vocabulary and basic sentence patterns through word problems are virtually limitless. Mathematical problems can also easily be changed into information gap activites in which two partners each have some information that the other one does not have, and they have to ask each other questions to obtain the missing information. But most importantly, mathematics develops problem solving skills, and these skills can be transferred to all other areas of learning.

Although mathematics has traditionally not been used in ESL teaching, I feel that it certainly merits consideration. Selected mathematical concepts and applications can add a stimulating and challenging component to the ESL curriculum. Conversely, mathematics content lessons can easily be adapted to facilitate language learning of LEP students.

REFERENCES

Bye, M.P. (1975). Reading in Math and Cognitive Development. Unpublished manuscript. (ERIC Document Reproduction Service No. ED 124926).

Cantoni-Harvey, G. (1987). Content-Area Language Instruction: Approaches and Strategies. The Center for Excellence in Education (Northern Arizona University). Reading, Ma.: Addison-Wesley. (See in particular chapter 8, "Mathematics," pp. 129-146).

Chamot, A.U. (1985). English Language Development through a Content-Based Approach. In Issues in English Language Development (pp. 49-55). Rosslyn, Va.: National Clearinghouse for Bilingual Education.

Commins, E. (1990). Big Book of Folder Games: for the Innovative Classroom. Atlanta, Ga.: Humanics Learning.

Cortez, E.G. (1983). Suggestions for a Relevant Elementary School Curriculum. TESL Talk, 14(3), 64-66.

Cuevas, G.J. (1984). Mathematics Learning in English as a Second Language. Journal for Research in Mathematics Education. 15(2), 134-144.

Dale, T.C. & Cuevas, G.J. (1987). Integrating Language and Mathematics Learning. In Crandall, J.A. (Ed.), ESL through Content-Area Instruction: Mathematics, Science, Social Studies (pp. 9-54). Center for Applied Linguistics/ERIC Clearinghouse on Languages and Linguistics. Englewood-Cliffs, N.J.: Prentice-Hall.

Hudelson, S. (1989). "Teaching" English through Content-Area Activities. In Rigg, P. & Allen, V.G. (Eds.), When They Don't All Speak English: Integrating the ESL Student into the Regular Classroom. Urbana, Ill.: National Council of Teachers of English.

Krashen, S. (1981). Second Language Acquisition and Second Language Learning. Oxford: Pergamon Press.

Krashen, S. (1982). Principles and Practice in Second Language Acquisition. Oxford: Pergamon Press.

Mathematics Today. (1987). 2nd ed. Orlando, Fl.: Harcourt Brace Jovanovich (Levels 1-4).

Mohan, B.A. (1986). Language and Content. Reading, Ma.: Addison-Wesley.

Reilly, T. (1988, May). ESL through Content-Area Instruction. ERIC Digest. Washington, D.C.: ERIC Clearinghouse on Languages and Linguistics.

Short, D.J. (1989). Adapting Materials for Content-Based Language Instruction. ERIC/CLL News Bulletin, 13(1). Washington, D.C.: ERIC Clearinghouse on Languages and Linguistics.

Snow, M.A., Met, M. & Genesee, F. (1989, June). A Conceptual Framework for the Integration of Language and Content in Second/Foreign Language Instruction. TESOL Quarterly, 23(2), 201-217.

Swain, M. (1988, November). Manipulating and Complementing Content Teaching to Maximize Second Language Learning. TESL Canada Journal/Revue TESL du Canada, 6(1), 68-83.